

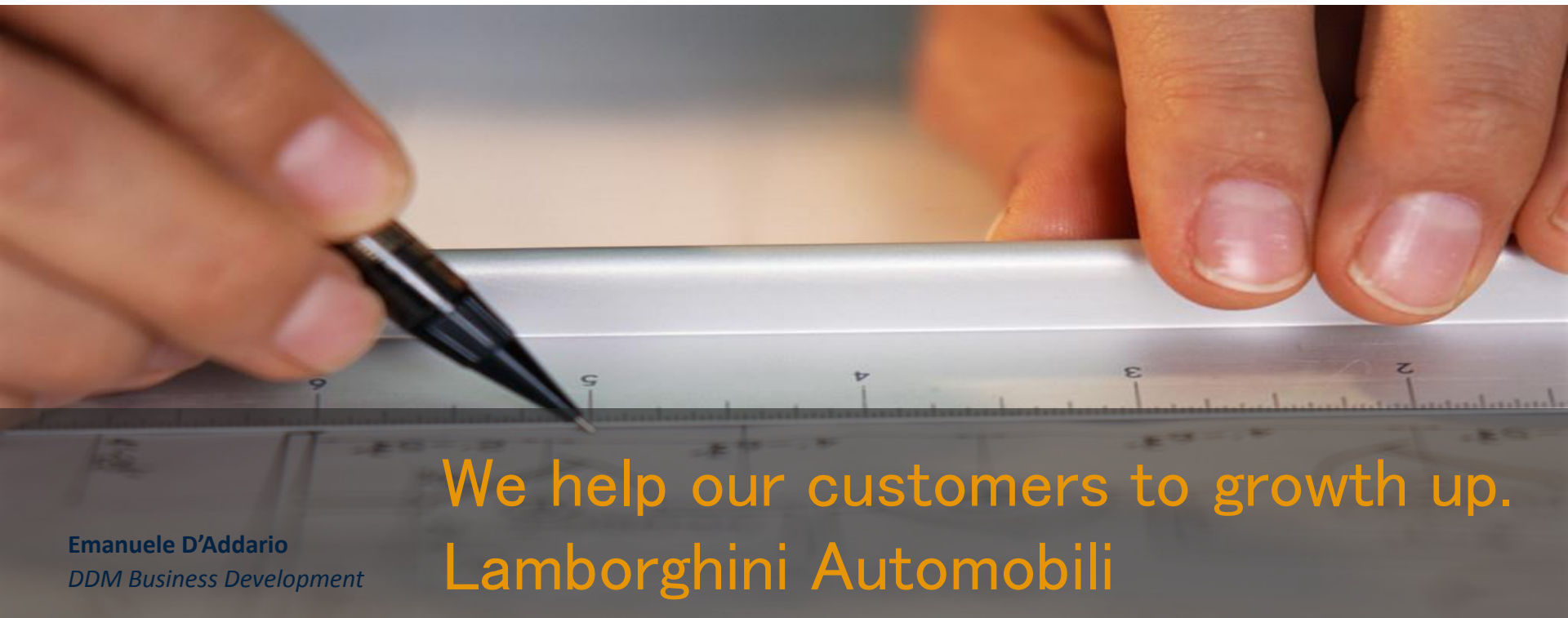


Stratasys

Automobili Lamborghini

18 Giugno 2015

Dr. Emanuele D'Addario
edaddario@energygroup.it



Emanuele D'Addario
DDM Business Development

We help our customers to growth up.
Lamborghini Automobili

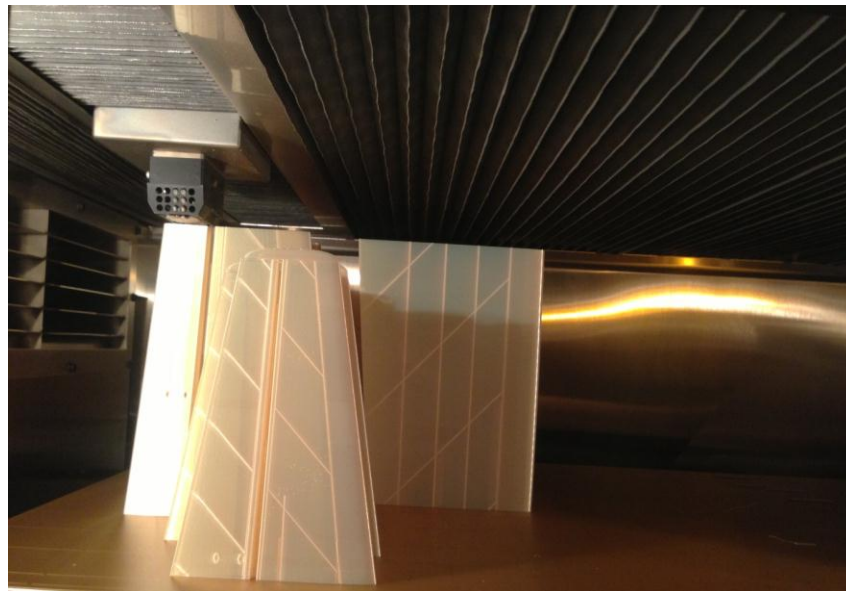
Energy Group S.r.l.

- Fatturato 2014: 6,4 M€
- Ci occupiamo di stampanti 3D dal 2005 come Rivenditori Stratasys
- 6 commerciali dedicati a 3DP
- 4 Tecnici certificati su FDM & Polyjet
- 3 Application Engineers
- 450 clienti attivi (3DP)
- Acquisizione Distribuzione Makerbot
- Acquisizione Distribuzione Spectrum Laser
- Collaborazione Ridix per AM materiali metallici
- Offerta servizi di reverse/prototipazione/scanner Hexagon



What Is FDM?

- Technology
- Materials
- Machines



FDM il Valore dei Materiali

- Production Grade Thermoplastics
- Proprietà meccaniche e termiche avanzate
- Produzione di end-use-parts
- High Accuracy
- La stabilità del materiale garantisce la realizzazione di parti accurate
- Accuratezza dichiarata +/- .089 mm Or +/- .0015 mm Per mm
- Stable Materials
- Design accurato
- Testing delle parti realizzate
- Repeatability
- Materiali stabili garantiscono ripetibilità
- Applicazioni DDM (Direct Digital Manufacturing)

Standard Materials



ABS-M30

- 6 Colors Available
- Great For
 - Prototypes

ABS-ESD7

- Electrical Conductivity
- Great For
 - Electrical Assembly Tooling



ASA

- UV Resistant
- Best Material For Light Weight Parts
- Great For
 - Parts Exposed To Sunlight

Engineered Materials



PC

- High Tensile And Flexural Strength
- Moderate Heat And Chemical Resistance
- Great For
 - High Requirement Prototypes
 - Manufacturing Tools
 - Wind Tunnel Testing

PC-ISO

- Good Aesthetics
- High Impact Resistance
- Great For
 - End Use Parts
 - Assembly Fixtures



Performance Materials



ULTEM 1010

- High Stiffness
- High Chemical Resistance
- High Temperature (213C HDT)
- Biocompatibility (ISO10993)
- Food Grade (NSF-51)
- Low Thermal Expansion (47 Mm/(M.°c))
- Great For
 - High Temperature Applications
 - Composite Tooling
 - End Use Parts

Applications

Functional Prototypes

Metal Forming Tools

Thermoforming Tools

Casting

Composite Tooling

Jigs and Fixtures

Wind Tunnel Testing



Functional Prototypes

Traditional Use Of All Additive Manufacturing

- Use The Final Production Material
- Quickly Produce And Test Designs
- Reduce Time To Market
- Fully Functional Parts



End Use Parts

Great for

- Bridge To Production
- Bridge To End Of Life
- Customized Products
- Short Production Runs
- Otherwise Impossible Components



Metal Forming Tools

Process

- Tool Design
- Build Tool From Suitable Material
- Finish Tool As Desired
 - Important For Thicknesses Less Than 2mm
- Form Metal Directly On FDM Tool
- No Need To Catalog Tool
 - Quick To Reproduce



Metal Forming Tools

Limits

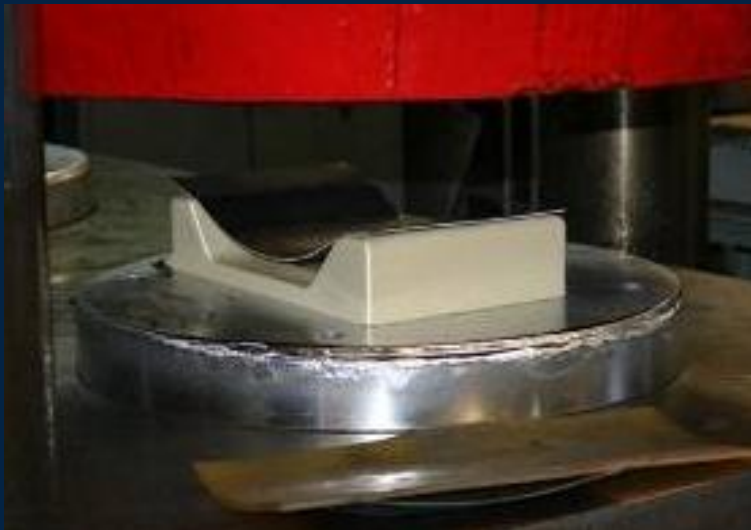
- Maximum Compressive Strength Varies By Material
 - ABS ~ 200 Bar
 - PC ~ 400 Bar
 - Ultem9085 ~ 900 Bar
- Great For Short Runs Of Parts
 - 1-100 Parts
- Tested With Multiple Processes
 - Hydro Forming
 - Stamping
 - Stretch Forming
 - Rubber Pad Press



Metal Forming Tools

Design Considerations

- Spring Back Is Less Than Steel Tooling
- Only Put Material Where You Need It
- Deep Draws May Require Intensifiers



Vacuum Forming Tools

Design Considerations

- General Tooling Design
- Natural Porosity Saves Time/Money
 - Vacuum Passages Are Set In Insight
- Vacuum Will Flow In Z More Than X-Y



Investment Casting

Limits

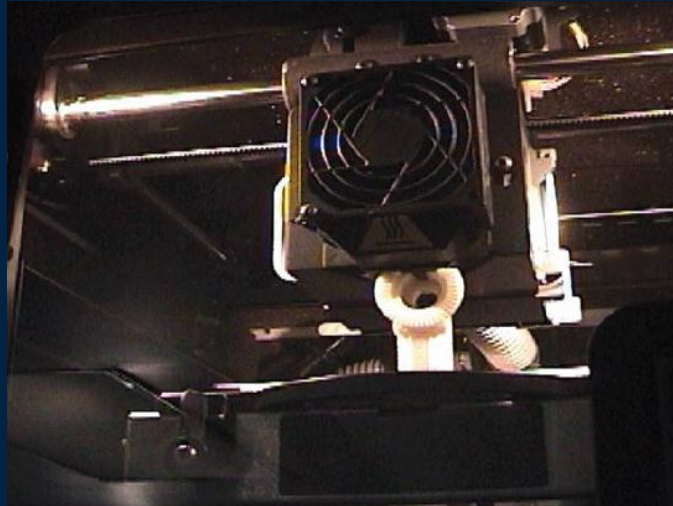
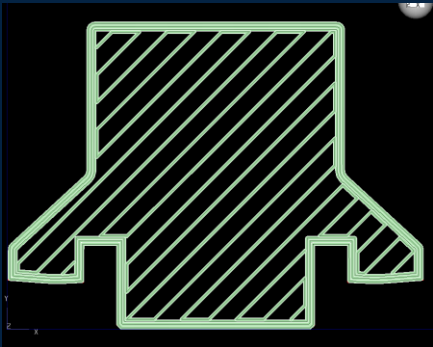
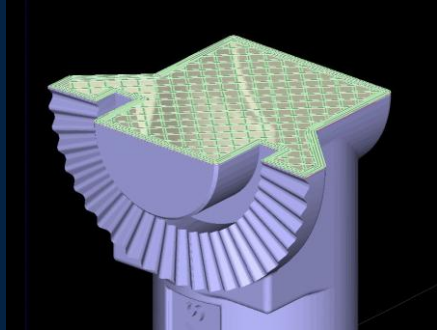
- Very Small Parts Are Better Produced With Wax
- Burn-out Process Is Different Than Melting Wax
- Best For 1-100 Parts



Investment Casting

Design Considerations

- Parts Should Be Built As Light Weight As Possible
 - Use Insight To Control Density
 - Less Material = Less Ash To Clean Out
- ASA Or ABS Should Be Used



Sand Casting

Process

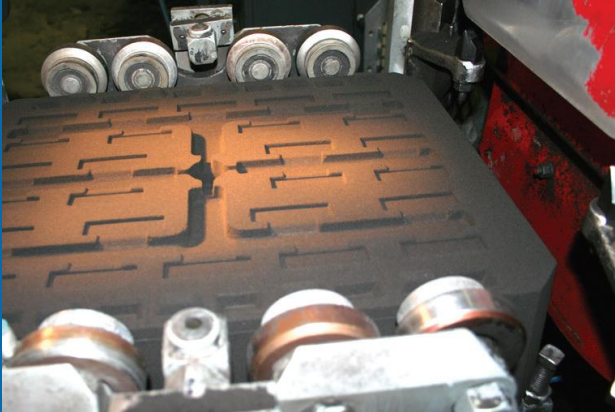
- Produce Needed FDM Component
 - Match Plates
 - Split Patterns
 - Loose Patterns
 - Core Boxes
- Use Pattern To Create Sand Casting Mold
- Create Metal Parts



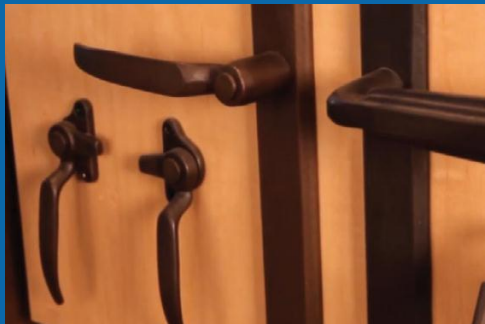
Sand Casting

Limits

- Size Limited By FDM Build System
 - Models Can Be Joined To Overcome This
- Compaction Pressure Below 200 Bar For ABS
 - Higher With Other Materials
- Best For Low To Moderate Volumes
 - 5,000+

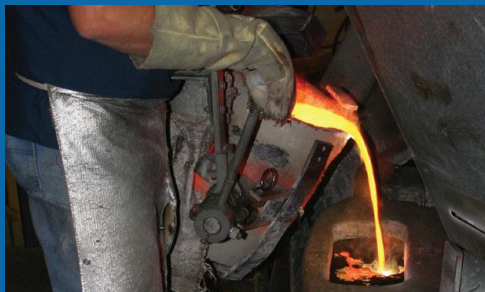


Sand Casting



Design Considerations

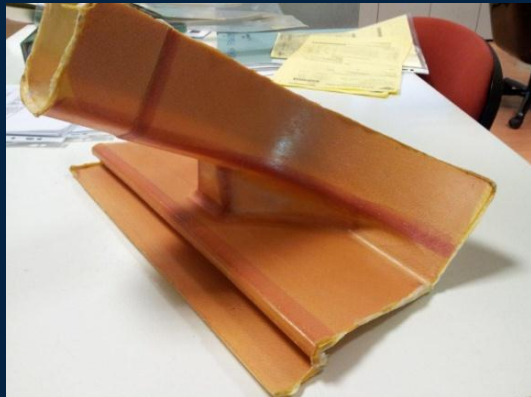
- Correct Material For Compressive Force
 - ABS ~ 200 Bar
 - PC ~ 400 Bar
 - ULTEM 9085 ~ 700 Bar
- Use FDM For The Complex Areas Of Patterns
 - Mold Inserts
- Finish FDM To Reach Required Surface Finish



Composite Tooling

Process

- Design Tool
- Build FDM Tool
- Finish And Seal Tool
- Apply Release Agent
- Produce Parts
- Repeat



Composite Tooling

Limits

- Temperature Limits Depend On Material
 - ABS – 95C
 - PC – 138C
 - Ultem 9085 – 168C
 - Ultem 1010 – 214C
- Full Autoclave Pressure Is OK
- Thermal Expansion Of FDM Materials Must Be Considered
- Great For Short To Medium Runs
 - 1-100 Parts



Composite Tooling

Design Considerations

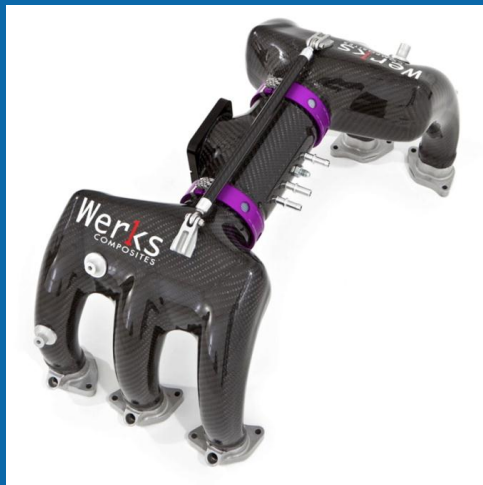
- Thin Tools Work Well With Envelope Bagging
 - Offsets Should Be Made In Insight
- CTE Of Materials Are Listed On Data Sheets
- Only Put Material Where Needed
 - Less Material = Less Time And Cost



Soluble Cores

Process

- Design Core Based On Internal Geometry
- Smooth And Seal Core
- Lay-up Composites And Consolidate
- Dissolve Core In Cleaning Tank
- Trim And Polish Final Part As Desired



Soluble Cores

Limits

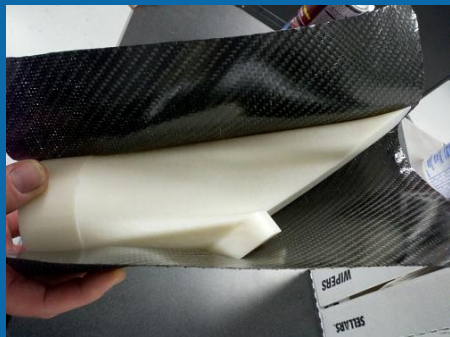
- Temperature Limits Depend On Material
 - SR30 – 80C
 - SR100 – 120C
- Full Autoclave Pressure Is OK
- Thermal Expansion Of FDM Materials Must Be Considered
- Great For Short To Medium Runs
 - 1-100 Parts



Soluble Cores

Design Considerations

- Design Internal Geometry Instead Of Tooling
- Optional
 - Design Flow Passages For Wash-Out
- Use CAD Data To Design Trim Tools



Un paio di
test ...
tornano
sempre utili



Jigs and Fixtures

Process

- Used In Many Different Ways
 - Test Fixtures
 - Holding
 - Automation
 - Quality Control



Jigs and Fixtures

Limits

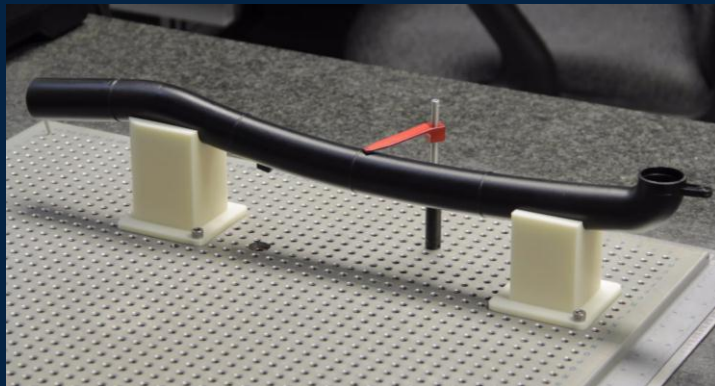
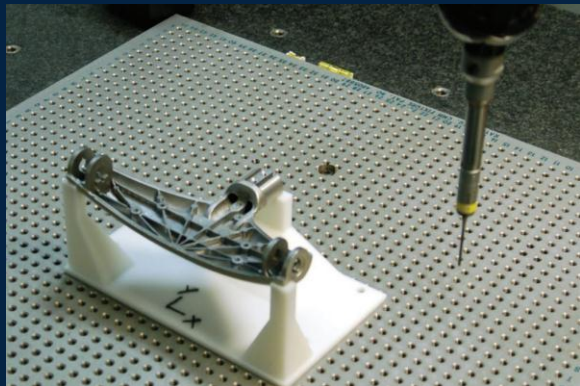
- Limits Are Defined By Material Data Sheets
 - Temperature
 - Strength
 - Stiffness



Jigs and Fixtures

Design Considerations

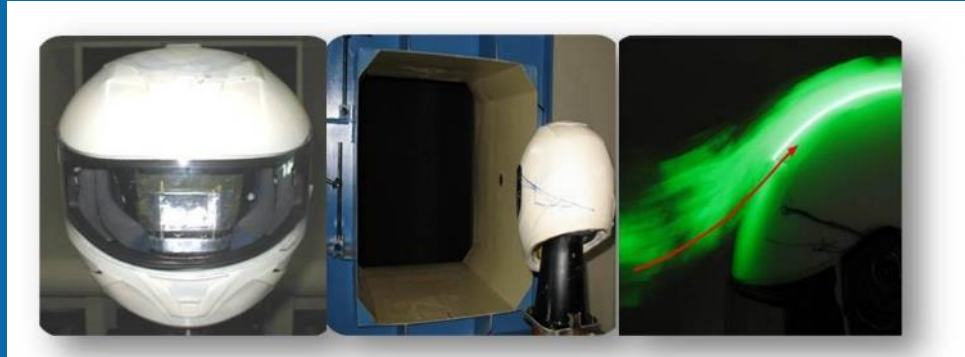
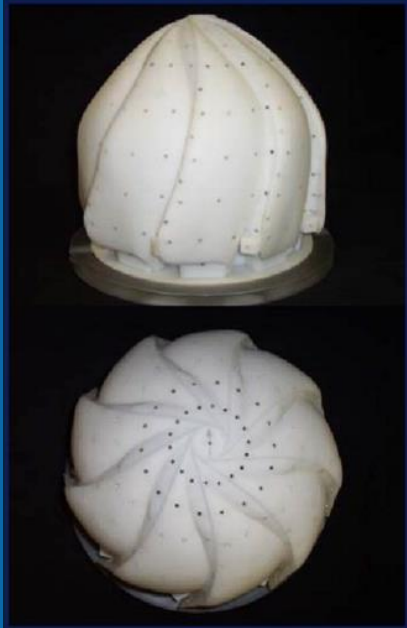
- Only Put Material Where It Needs To Be
- Design For Function
- Wear Surfaces Can Be Coated Or Platted To Increase
- Can Be Machined To Achieve Tighter Tolerances



Wind Tunnel Testing

Process

- Design Component
- Build
- Finish As Needed For Surface Quality
 - Sanding, Painting, And Epoxy Fillers
- Test Components
- Repeat As Needed



Wind Tunnel Testing

General Considerations

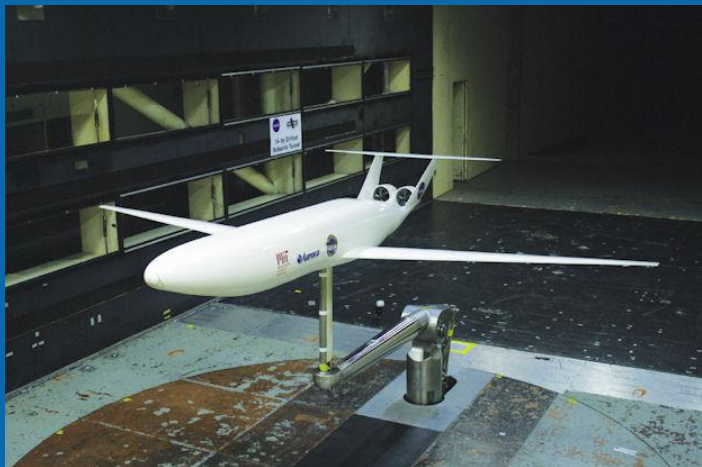
- Low Speed Wind Tunnels
 - Ultra Sonic For Short Times
- Flexural Modulus Of Materials Should Be Noted



Wind Tunnel Testing

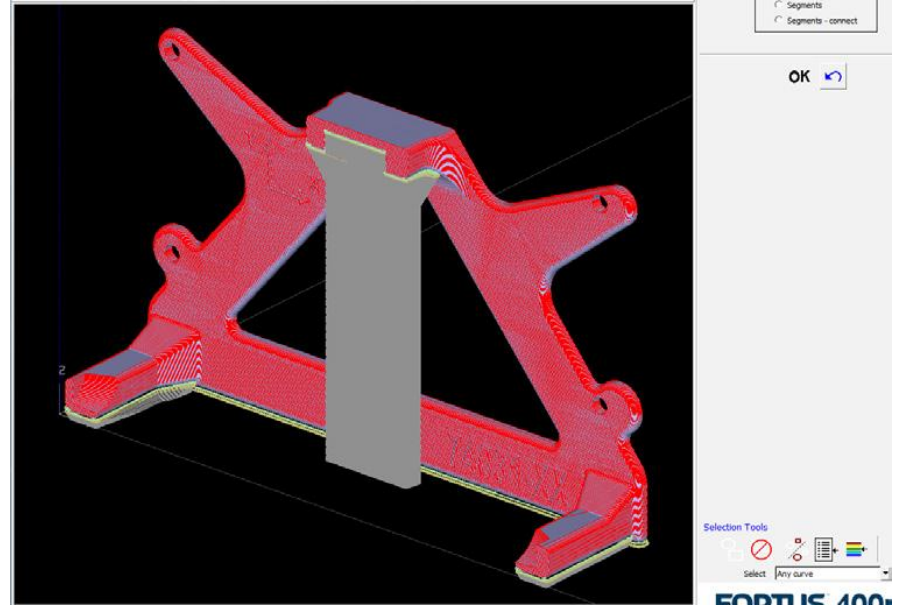
Design Considerations

- Parts should be built for best surface finish
 - Thin Layers
 - Proper orientation
- All Material Data Sheets Have Flexibility Data
- Insert Stiffeners In Long, Thin Features



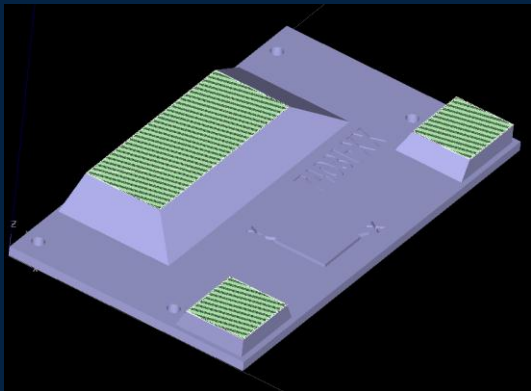
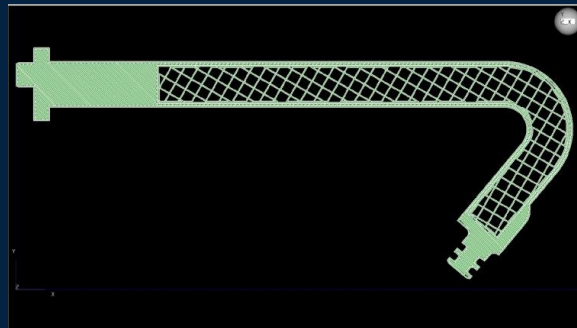
Software Advantages

- Basic Overview
- Different Build Styles
- Design for FDM



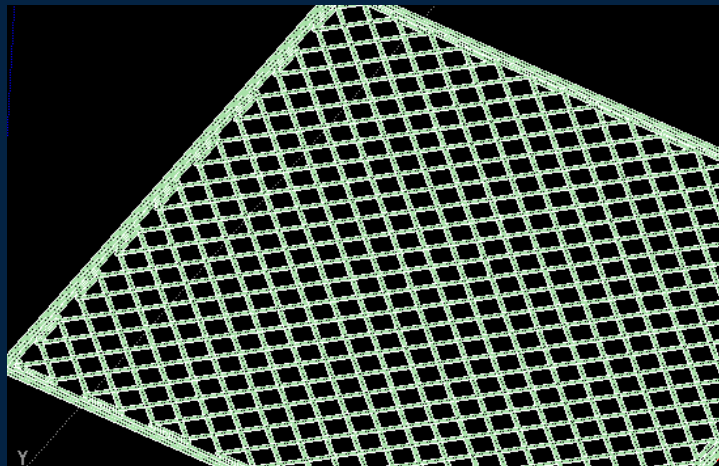
Basic Overview

- Insight Software
- Basic Functions
 - Orientate Part
 - Slice
 - Support
 - Build!
- What It Shows
 - Model And Support Material
 - Toolpaths
 - Build Times And Material Usage



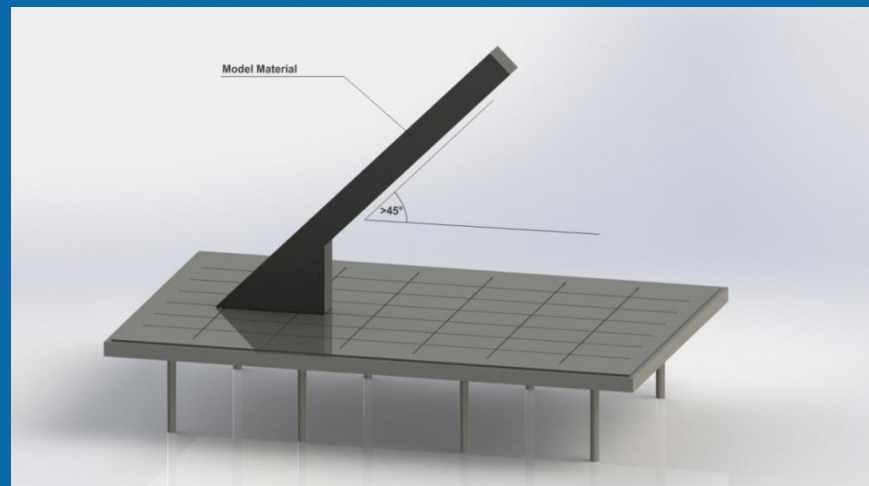
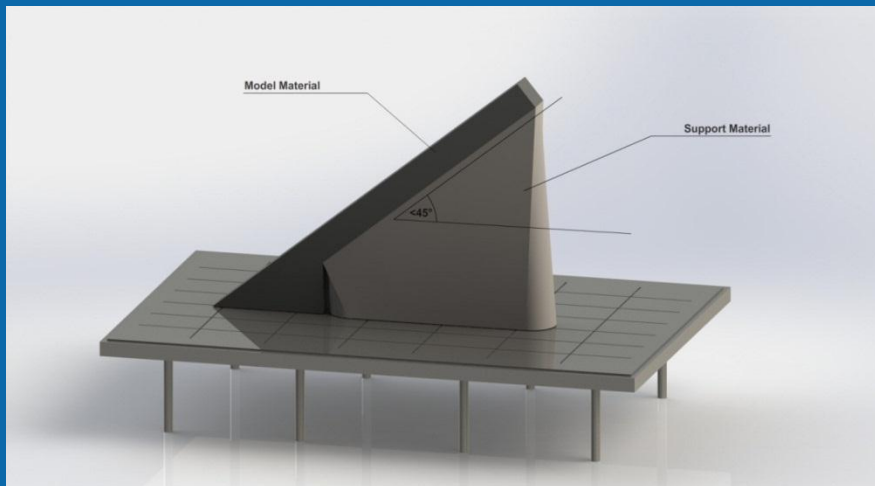
Build Style Differences

- Solid
- Sparse
- Sparse Double Dense
- Inverted Materials



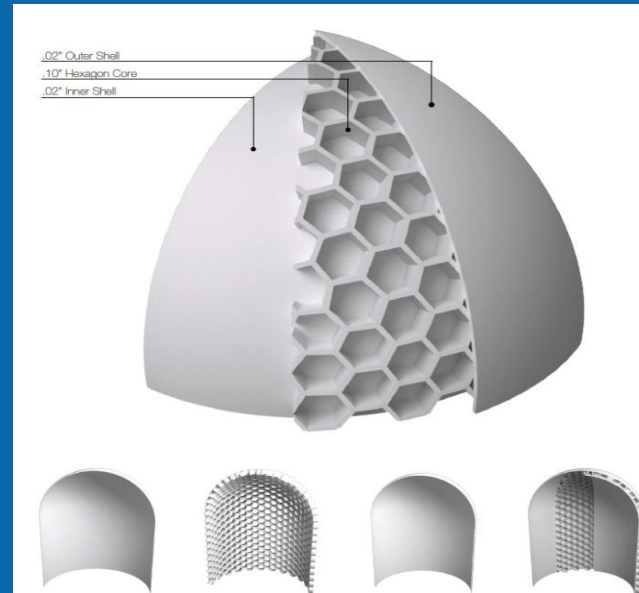
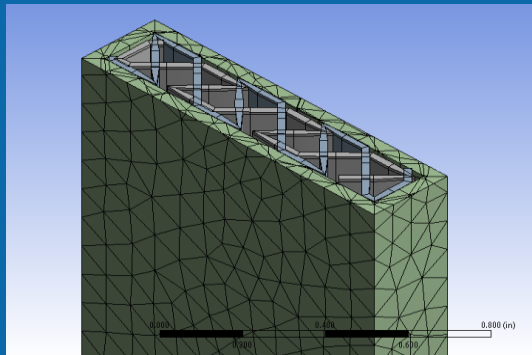
Design For FDM

- Self Supporting Angles
 - 45 Degrees
- Thin Walled Tubes
 - Why Offsetting In CAD Is A Challenge
- Thin Walled Tooling



Design for FDM

- Add Material Only Where Needed
- Topology Optimization Results Can Now Be Produced
- Complexity Does Not Add Cost



Design for FDM

End Of Arm Tool Example

- Remove Unnecessary Mass
- Create Self-Supporting Angles
- Optimal Mass Distribution
 - Hollow Interior
- Integrated Vacuum Passages



Special Questions?

- Technology
- Materials
- Applications
- ~~The Meaning of Life ?~~
- Future Development



To be continued...

